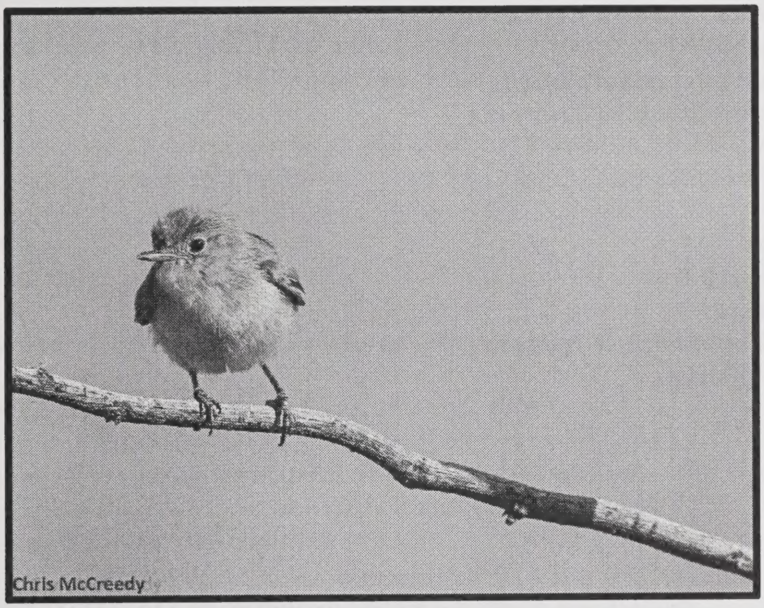
Point Blue
Conservation
Science

Amargosa Canyon Songbird Project
2015 Report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Point Blue Contribution No. 2062
December 2015

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TABLE OF CONTENTS

Summary 3
Introduction 4

1 Methods

1.1 Study Design 5
1.2 Territory Mapping 9
1.3 Nest Finding and Monitoring and Nest Vegetation Measurements 9
1.4 Brown-headed Cowbird Censuses 9
1.5 Statistical Analyses 9
1.6 Endangered Species Surveys 10
1.7 Brown-headed Cowbird Trapping 10

2 Results and Discussion

2.1 Bell's Vireos 14
2.2 Willow Flycatchers 16
2.3 Nesting Species 17
2.4 Brown-headed Cowbird Trapping 19
2.5 Territory Density 21

Literature Cited 23

ACKNOWLEDGEMENTS

We would like to thank the US Fish & Wildlife Service (Las Vegas and San Bernardino/Ventura Offices), the Bureau of Land Management (Barstow and Desert District Offices), the Amargosa Conservancy, the Nature Conservancy, and the California Department of Fish & Wildlife for their guidance, use of facilities, and funding for this work. We gratefully thank Susan Sorrells and Brian Brown for their continued interest in this project and for access to their property in order to make this research a success. Special thanks to Richard and Carol Cantino, Darlene Feener, for their past and continuing volunteer efforts to help our work. Len Warren and Eduardo Martinez Leyva conducted field surveys, tended cowbird traps, and saw this project through to its completion.

Suggested Citation: McCreedy, C. and Warren, L.S. 2015. Amargosa Canyon Songbird Project: 2015 Report. Point Blue Conservation Science, 3820 Cypress Drive #11, Petaluma, CA, 94954. Point Blue Contribution No. 2062.

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SUMMARY

Since 2005, Point Blue Conservation Science (Formerly PRBO) has coordinated with the US Fish and Wildlife Service, the Bureau of Land Management, the California Department of Fish and Wildlife, the Amargosa and Nature Conservancies, China Ranch Date Farm, and private residents of Shoshone and Tecopa, CA to implement the Amargosa Canyon Songbird Project. Project objectives are:

1] Survey for Federally Endangered Southwestern Willow Flycatchers (*Empidonax traillii extimus*) and Least Bell's Vireos (*Vireo bellii pusillus*) on the Amargosa River, Inyo County, CA.

2] Initiate and maintain a Brown-headed Cowbird (*Molothrus ater*) trapping program at Shoshone, Tecopa, and the China Ranch Date Farm.

3] Assess exotic *Tamarix* removal and cowbird trapping effects on all breeding bird species at Shoshone and Amargosa Canyon reaches of the Amargosa River.

Key 2015 results include:

- **8 Bell's Vireo territories** (six at Shoshone and two in the Amargosa Canyon).
- **Record-high 25 Bell's Vireo fledglings** at Shoshone.
- **34 Brown-headed Cowbird captures, including 12 females**. We continue to minimize the threat of brood parasitism, and only 2 cowbirds were observed on plots during 450 hours of surveys during the cowbird season.
- **0 nests (all species) lost to Brown-headed Cowbird parasitism.**
- **Nest success was again high in 2015** (44/64) nests fledged, 69% Proportional Success for all species combined, 66% proportional success for open cup nests.
- **High productivity.** Potential cowbird hosts again produced over 2 fledglings for each brood attempt, over double low productivity observed prior to cowbird trapping begun in 2007.

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INTRODUCTION

In 2005, Point Blue Conservation Science (then PRBO) initiated the Amargosa Canyon Songbird Project (the Project) in collaboration with the Bureau of Land Management's Barstow Field Office and the US Fish and Wildlife Service's Ventura Office. The Project began as an effort to locate breeding territories and nests of Federally Endangered Southwestern Willow Flycatchers and Least Bell's Vireos in advance of *Tamarix* removal on the Amargosa River and its tributary, Willow Creek (USFWS 2005). The Project area lies within the Amargosa Canyon Area of Critical Environmental Concern and within the Amargosa Wild and Scenic River. The entire Project area also lies within the Shoshone-Tecopa Important Bird Area (IBA), and was recently designated a California Watchable Wildlife Area.

Riparian habitats cover only a small percentage of California (<0.5%), yet they may be the most important habitat for land bird species in California (Riparian Habitat Joint Venture 2004). Desert riparian habitats are by definition isolated and rare, and they face multiple threats. These threats include exotic plant invasions, increased fire frequency, domesticated and feral livestock overgrazing, groundwater pumping, and acreage loss to urbanization (RHJV 2004). Only 2 – 15% of California's original desert riparian habitat still exists, and much of remaining riparian habitats are fragmented and degraded (RHJV 2004).

Partners In Flight (PIF) represents a cooperative approach to land bird conservation amongst federal and state agencies, academia, non-profit organizations, industry, and philanthropic groups (http://www.partnersinflight.org/description.cfm). It has existed since 1990. As members of PIF and its California Partners In Flight (CalPIF) state chapter, Point Blue, the BLM, and the USFWS have sought to follow PIF's core objectives of helping species at risk, keeping common birds common, and developing voluntary partnerships for birds, habitats, and people. Point Blue seeks to accomplish this by providing high-quality data collection and analyses to PIF contributors throughout the western United States. Thus Point Blue has placed strong emphasis on all-species data monitoring and data collection, in order to contribute our findings on the entire avian community to land managers, to California Partners In Flight, and to inter-agency planning efforts such as the Riparian Joint Venture.

The Amargosa River's riparian habitat is highly isolated due to its location in the central Mojave Desert, and it houses disjunct populations of several riparian bird species that are susceptible to local extirpation in the absence of sound management practices. Sensitive bird species that have been seen in the area include the federally listed Least Bell's Vireos (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Additionally, several other California Bird Species of Special Concern (Shuford and Gardali 2008) are found to breed on the Amargosa River at Amargosa Canyon and Shoshone, including Crissal Thrashers (*Toxostoma crissale*), Lucy's Warblers (*Oreothlypis luciae*), Yellow Warblers (*Setophaga petechia*), Yellow-breasted Chats (*Icteria virens*), and Loggerhead Shrikes (*Lanius ludovicianus*). The Amargosa River represents the northwestern edge of the breeding ranges of several Mojave and Sonoran Desert species, such as Lucy's Warblers, Crissal Thrashers, Verdin (*Auriparus flaviceps*), Black-tailed Gnatcatchers (*Polioptila melanura*), Brown-crested Flycatchers (*Myiarchus tyrannulus*), Ladder-backed Woodpeckers (*Picoides scalaris*), and a Sonoran Desert subspecies of Song Sparrow (*Melospiza melodia fallax*). The Western Yellow-billed Cuckoo (*Coccyzus americanus*), which is proposed for federal listing, used to be found in the Amargosa Valley area historically.

Given this high avian diversity, surveying for Southwestern Willow Flycatchers and Least Bell's Vireos on the Amargosa River presented Point Blue a unique opportunity to stretch agency funds and gather territory and nest data on the Amargosa Canyon's entire avian community, in order to gauge the avian community's response to *Tamarix* removal and subsequent Brown-headed Cowbird (*Molothrus ater*) trapping.

Previous research has noted that we should consider *Tamarix* removal's value to the riparian avian community, weighing the effects of geography, landscape, and the likelihood that the restored riparian zone will provide high-quality native habitat (Sogge et al. 2006). However, while *Tamarix* removal from southwestern riparian habitats is an important objective for several federal and state agencies, these agencies lack pre- and post-treatment land bird data to apply adaptive management to *Tamarix* eradication projects (Sogge et al. 2006).

In the meantime, the current data that does exist on avian response to *Tamarix* eradication is mixed. Sogge et al. (2006) found that *Tamarix* habitats were not detrimental to Southwestern Willow Flycatcher physiology, immunology, site fidelity, productivity, and survivorship in Arizona. Ellis (1995) found that bird species richness does not diminish in *Tamarix*-dominated habitats, but that species composition only changes – suggesting that maintenance of native riparian habitats will be necessary to conserve certain land bird breeding species in riparian zones of the Southwest. Sogge et al. (2006) found that the area and volume of *Tamarix* stands in the Grand Canyon were among the best positive predictors of bird species abundance, richness, and diversity. Sogge et al. (2008) noted that *Tamarix's* value as habitat varies substantially by geography and by bird species under consideration. At the Lower Colorado River, Van Riper et al. (2008) found that while *Tamarix* monocultures have lower breeding bird abundance, breeding bird abundance increases significantly if native vegetation reaches 20-40% of riparian cover.

Thus our all-species approach at the Amargosa Canyon will provide the BLM and USFWS with up-to-date information on Bell's Vireo and Willow Flycatcher territory location to assist restoration efforts, while simultaneously providing much-needed data on the entire riparian avian community's response to *Tamarix* removal and Brown-headed Cowbird management.

1 METHODS

1.1 Study Design

We initiated 32.7 ha plot at the north end of the Amargosa Canyon (AMNO) in 2005, as well as a 31.8 hectare plot near Shoshone (SHOS) in 2006 (Figures 1a - b). Though the SHOS and AMNO plots each once contained significant amounts of *Tamarix*, they are generally now dominated by native vegetation post *Tamarix*-removal.

The AMNO plot was entirely burned in an arson-caused fire in 2002, and it is in regeneration. Much of the AMNO plot again burned in 2010, due to another fire. The southern boundary of the AMNO plot matches the 2002 burn's southern extent. The AMNO plot is dominated by *Salix exigua* and isolated, recovering clones of *Salix gooddingii*. By early 2010, these *S. gooddingii* had recovered to reach over 5 m in height, but most were then lost to 2010 fire in late summer.

In addition to willows, upland and transition areas of the AMNO plot hold large patches of dense *Atriplex lentiformis*, *Pluchea sericea*, and *Phragmites australis*, with isolated pockets of *Prosopis glandulosa* and *Prosopis pubescens*. Some of these *Prosopis* patches are tucked into rocky areas that escaped the 2002 burn. The wettest reaches of the AMNO plot are becoming choked with *Typha* and *Schoenoplectus maritimus*. Both native and exotic vegetation have recovered rapidly after the fire, and BLM crews removed *Tamarix* re-growth across the southern half of the plot in the winter of 2006. Crews again removed *Tamarix* from the southern half of the AMNO plot in the winter of 2015, prior to this past breeding season. We have monitored the AMNO plot for all species each season, beginning in 2005.

The SHOS plot is approximately 20 miles upstream of Amargosa Canyon, near the town of Shoshone. The SHOS plot was initiated in 2006, prior to *Tamarix* removal. It is more xeric than the Amargosa Canyon plots, and prior to *Tamarix* eradication, the SHOS plot was dominated by *P. pubsescens, P. glandulosa*, *A. lentiformis*, and *Tamarix*. In addition, the SHOS plot also held isolated groves of *Tamarix aphylla* that reached approximately 10 m in height. Nearly all of this *Tamarix* cover was removed by the BLM prior to the 2007 field season, and the BLM and other groups have returned to the SHOS plot to control *Tamarix* regeneration after the 2007 field season. We have monitored the SHOS plot for all species since 2006. In addition, we surveyed approximately 25 hectares of the riparian zone south of Highway 178 in 2007-2009 for Least Bell's Vireos and Southwestern Willow Flycatchers in preparation for scheduled *Tamarix* eradication.

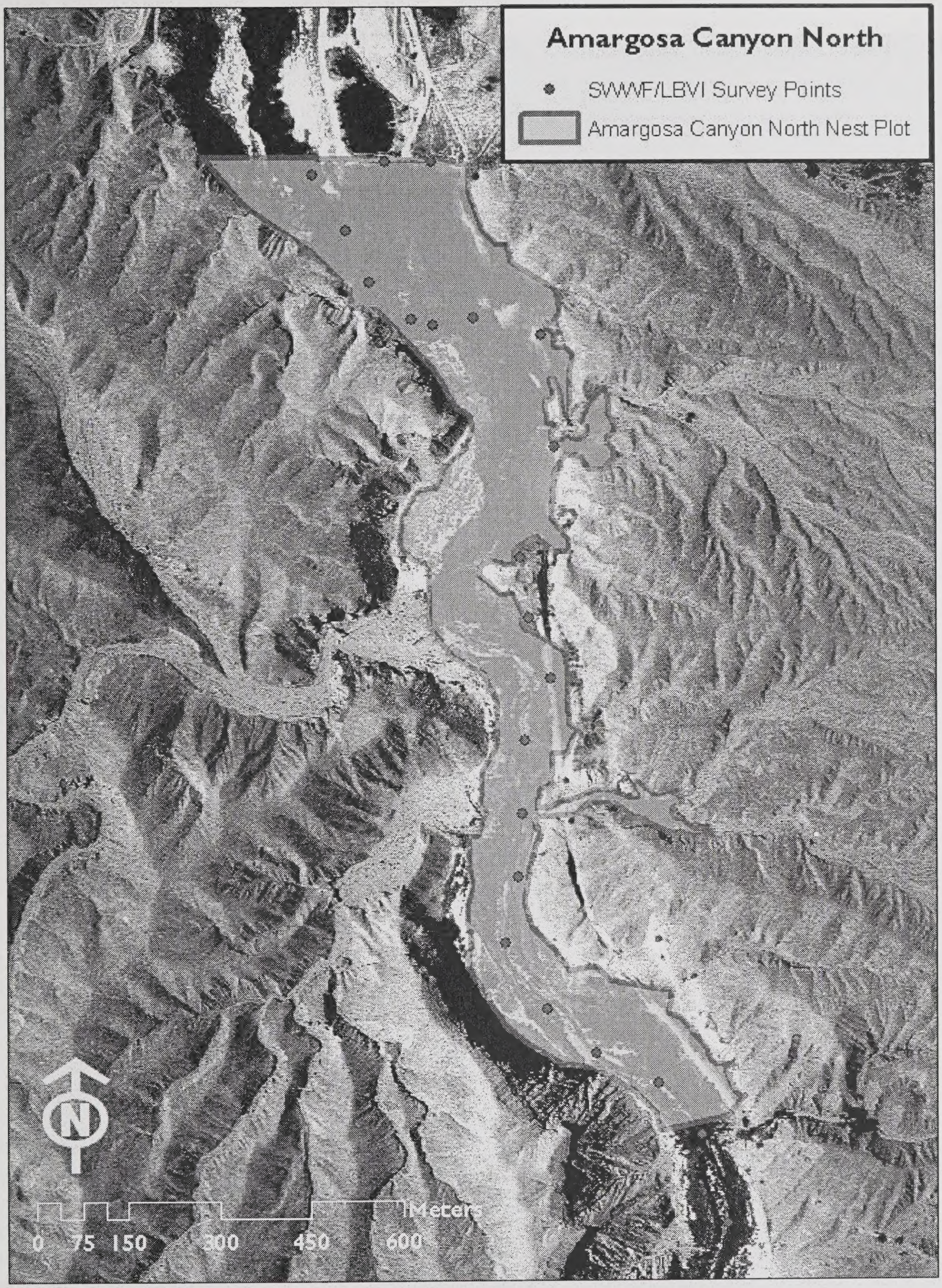

Figure 1a. Amargosa North (AMNO) nest plot, with Southwestern Willow Flycatcher and Least Bell's Vireo playback survey points. Monitored 2005-2015.

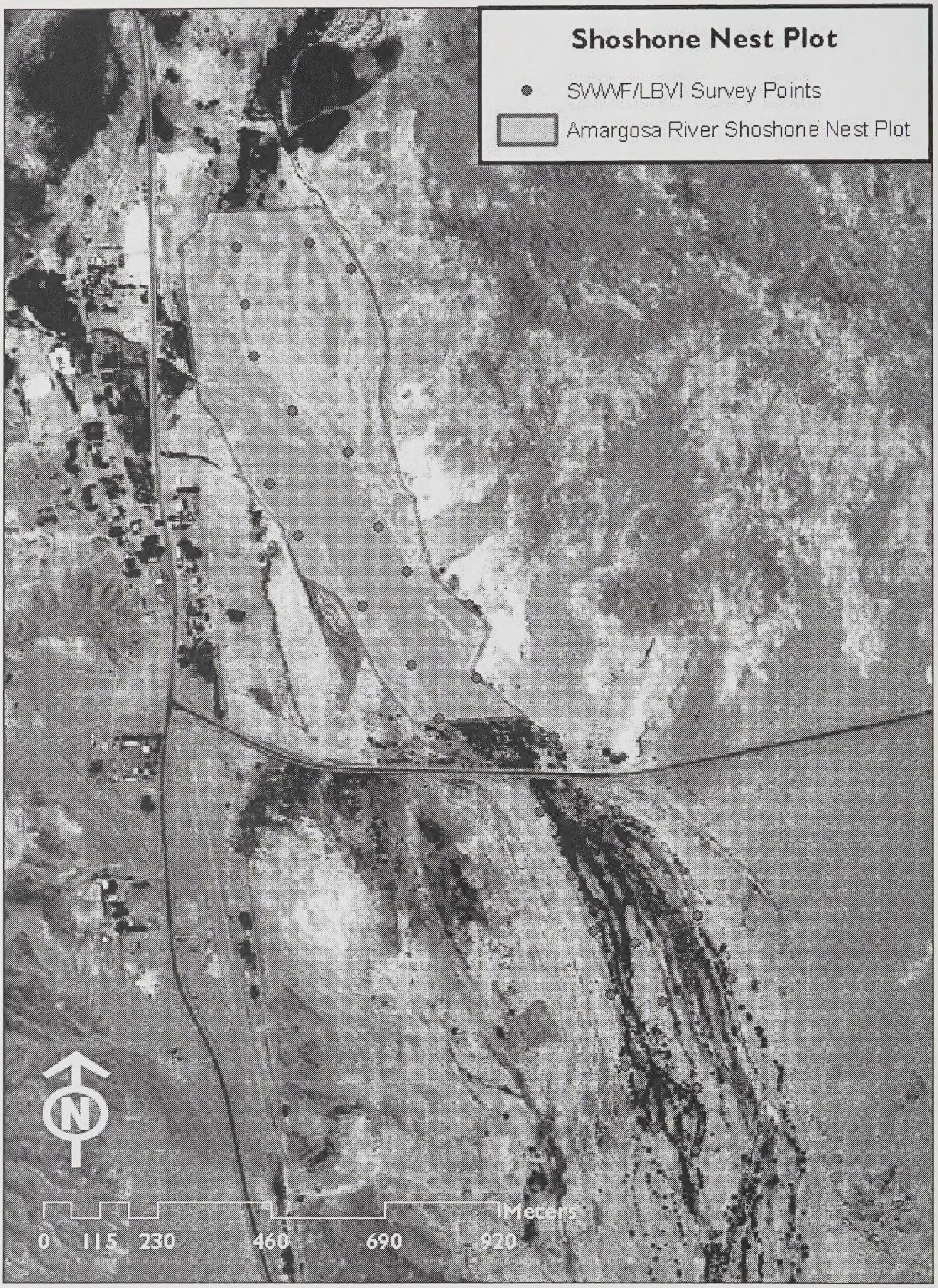
Shoshone Nest Plot
● SWWF/LBVI Survey Points
▨ Amargosa River Shoshone Nest Plot
N
Meters
0
115
230
460
690
920

Figure 1b. Shoshone (SHOS) nest plot, with Southwestern Willow Flycatcher and Least Bell's Vireo playback survey points. Monitored 2006-2015.

1.2 Territory Mapping.

Using UTM-gridded maps and GPS Garmin GPSmap receivers, we mapped territorial behaviors and nests for all species present on each plot for three to four days each week, May 7 – July 31. We followed guidelines suggested in International Bird Census Committee recommendations (IBCC 1970) and Ralph et al. (1993). At the end of the season, we compiled daily spot maps to create territory maps for each breeding species. Territory numbers were summarized following Hall (1964). We summarized non-territorial species (e.g. Mourning Doves, House Finches) by number of detected nesting females.

1.3 Nest Finding and Monitoring and Nest Vegetation Measurements

We located nests on each plot, which we then monitored at least once every four days, following protocols described in Martin and Geupel (1993), Martin et al. (1997), and Rourke (1999). We recorded nest contents and Brown-headed Cowbird parasitism on each visit to the nest, until the nest's subsequent fledge or failure. After nesting was complete, we conducted 5 m-radius and 11.3 m-radius vegetation assessments about each nest following Martin et al. (1997). Using the same protocol, we conducted thirty non-nest vegetation assessments at randomly-generated locations on each plot each season.

Nest and non-nest assessments included absolute cover estimates of shrub cover, non-woody cover, and groundcover. Groundcover was broken into "litter", "bare ground", and "rock". We estimated relative covers (by species) of absolute shrub and non-woody cover and we multiplied these relative species covers by absolute shrub and non-woody cover to give by-species absolute cover estimates for analysis. Numbers of "tree" stems (stems 5 m in height and over 8 cm in diameter at breast height (DBH)) were recorded by DBH size categories in 11.3 m-radius plots around each nest and non-nest point. Canopy measurements included: "canopy height", the maximum height of the canopy above the nest, and "canopy cover", the percent of the 11.3 m-radius plot covered by vegetation greater than 5 meters in height.

1.4 Brown-headed Cowbird Censuses

We tallied of Brown-headed Cowbirds daily on all plot visits from beginning of the day's survey until the end, to provide a per-hour index of cowbird abundance. By-hour tallies were only estimated in 2011 and 2012.

1.5 Statistical Analyses

We limited nest survivorship calculations to a pool of nests with known outcome and which were observed with at least one egg or young. We calculated nest survivorship for this report as Proportion Successful (Martin 1992).

Host eggs that disappeared in coincidence with the appearance of a new cowbird egg were assumed to be ejected by Brown-headed Cowbirds. Eggs that did not hatch in parasitized nests were presumed to not hatch due to cowbird parasitism. We considered nests as successful if at least one fledgling was observed, if parents were observed with repeated food carries to single locations, or if nestlings were seen within four days of the expected fledge date (and subsequent timing of re-nesting attempts did not point to nest failure of the original nest).

1.6 Endangered Species Surveys

In its *Biological Opinion for the Saltcedar Removal and Riparian Restoration Project within the Amargosa River Drainage* (2005), the USFWS asserted that the BLM should survey for federally-endangered Southwestern Willow Flycatchers (*Empidonax traillii extimus*) and Least Bell's Vireos (*Vireo bellii pusillus*), to minimize potential take during *Tamarix* eradication efforts (29).

We followed all Southwestern Willow Flycatcher and Least Bell's Vireo survey techniques and schedules outlined in Attachments A and B of the USFWS *Biological Opinion* (USFWS 2005), Sogge (2000 and 1997) and Rourke et al. (1999) in order to locate, map, find and monitor nests, and establish buffers for these species in advance of *Tamarix* eradication. In addition, our constant spot-mapping effort on the SHOS, AMNO, and AMSO plots enabled us to detect additional Bell's Vireos and Willow Flycatchers not detected during presence/absence surveys. Spot-mapping and nest-monitoring methodologies are found in Section 1.1.3 of this report.

Survey point locations are provided in Figures 1a-1c. All points in the Amargosa Canyon were surveyed in 2005-2015. Points near Shoshone were surveyed in 2006-2015.

1.7 Brown-headed Cowbird Trapping

We conducted Brown-headed Cowbird trapping following methods described in McLeod et al. (2007). We used eight funnel-shaped Brown-headed Cowbird traps built by SWCA Consultants (the authors of the McLeod et al. report).

Trap locations are depicted in Figures 2a-c. We placed two traps on the SHOS plot, and one trap on the AMNO plot. In addition, we placed two traps at nearby China Ranch, where the densest population of Bell's Vireos in the project area exists. We also placed one trap north of the AMNO plot in Tecopa, near a horse corral where we found Brown-headed Cowbirds gathering in 2005 and 2006. We also placed a cowbird trap at the Crowbar Café in Shoshone, another location where cowbirds frequently gather and feed.

We checked traps at least once every 24 hours, and we replenished them with water and seed regularly. We noted all new and existing cowbird captures during each trap check, and we recorded and released all non-target captures. At the direction of the USFWS, we only euthanized female cowbirds. We immediately released juveniles, and we kept males in traps as decoys. We clipped adults' wings to prevent injury while being used as decoys.

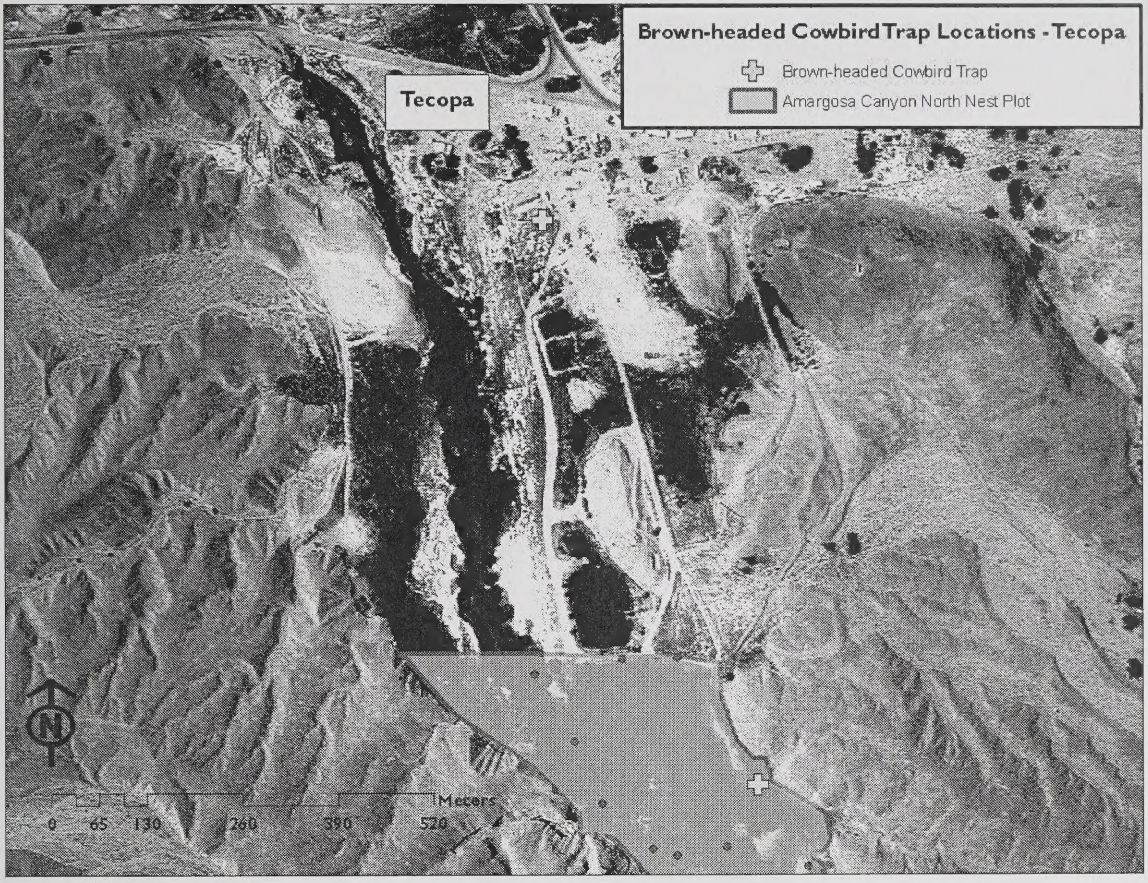
Brown-headed Cowbird Trap Locations - Tecopa
Brown-headed Cowbird Trap
Amargosa Canyon North Nest Plot
Tecopa
N
Meters
0
65
130
260
390
520

Figure 2a. Two Brown-headed Cowbird trap locations near the Amargosa River at Tecopa, CA. The Amargosa North (AMNO) nest plot is shaded blue.

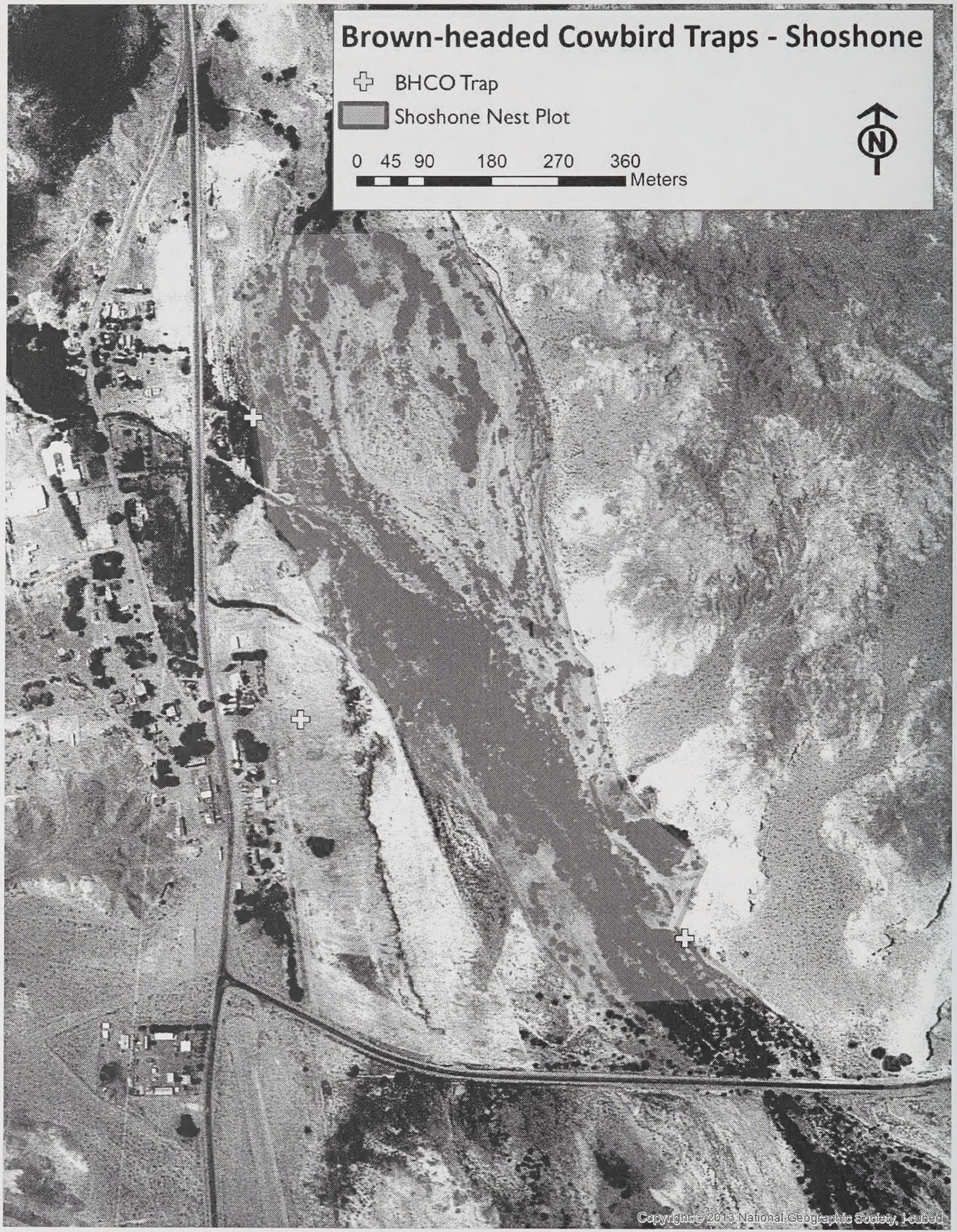
Brown-headed Cowbird Traps - Shoshone
BHCO Trap
Shoshone Nest Plot
0 45 90 180 270 360
Meters
N
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Figure 2b. Three Brown-headed Cowbird trap locations near the Amargosa River at Shoshone, CA. The Shoshone (SHOS) nest plot is shaded purple.

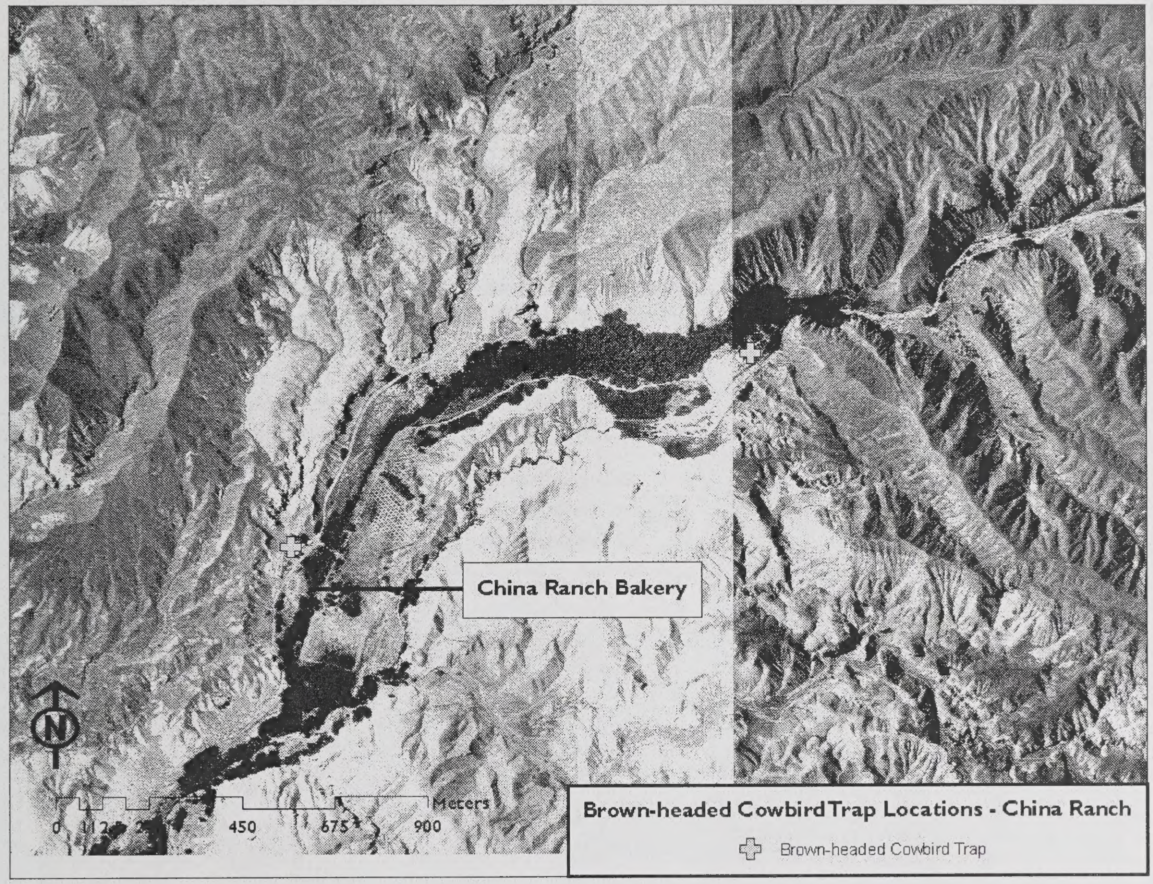
China Ranch Bakery
N
0
112
450
675
900
Meters
Brown-headed Cowbird Trap Locations - China Ranch
✚ Brown-headed Cowbird Trap

Figure 2c. Two Brown-headed Cowbird trap locations at China Ranch on Willow Creek, a tributary of the Amargosa River.

2 RESULTS AND DISCUSSION

2.1 Bell's Vireos

We detected eight Bell's Vireo territories in 2015 (six territories on the SHOS plot and two on the AMNO plot). We also monitored nests of an additional ninth, off-plot territory that nested in the town of Shoshone. Eight territories matches the highest number we have observed on the plots in one season. However, Bell's Vireos have not bred on the AMNO plot since *Tamarix* removal in 2014, and the two territorial males present in 2015 did not have mates. Figures 3a and 3b show territory and nest locations, and Table 1 lists nest locations, substrates and outcomes.

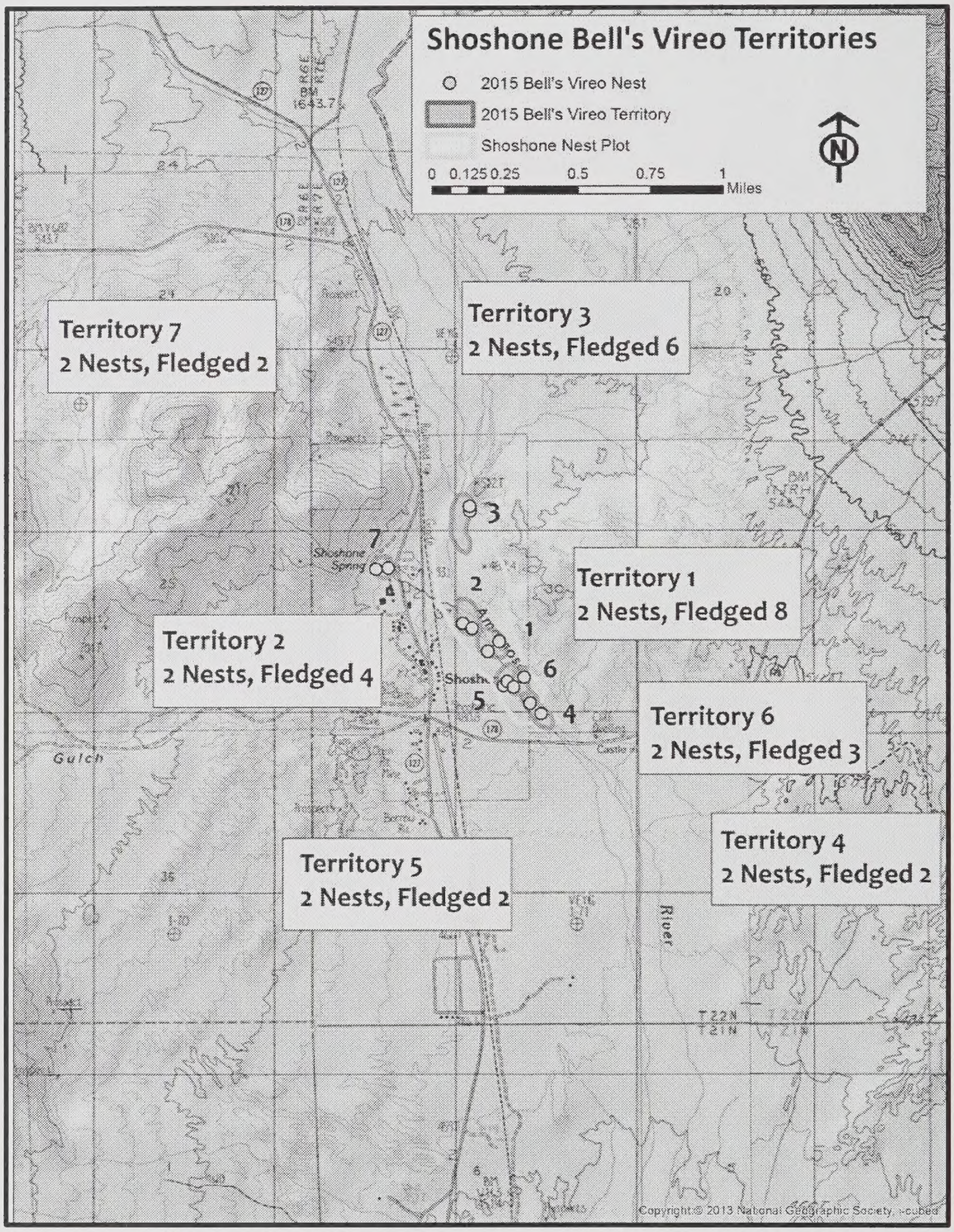

Figure 3a. Bell's Vireo territory locations and nests, Shoshone plot (2015).

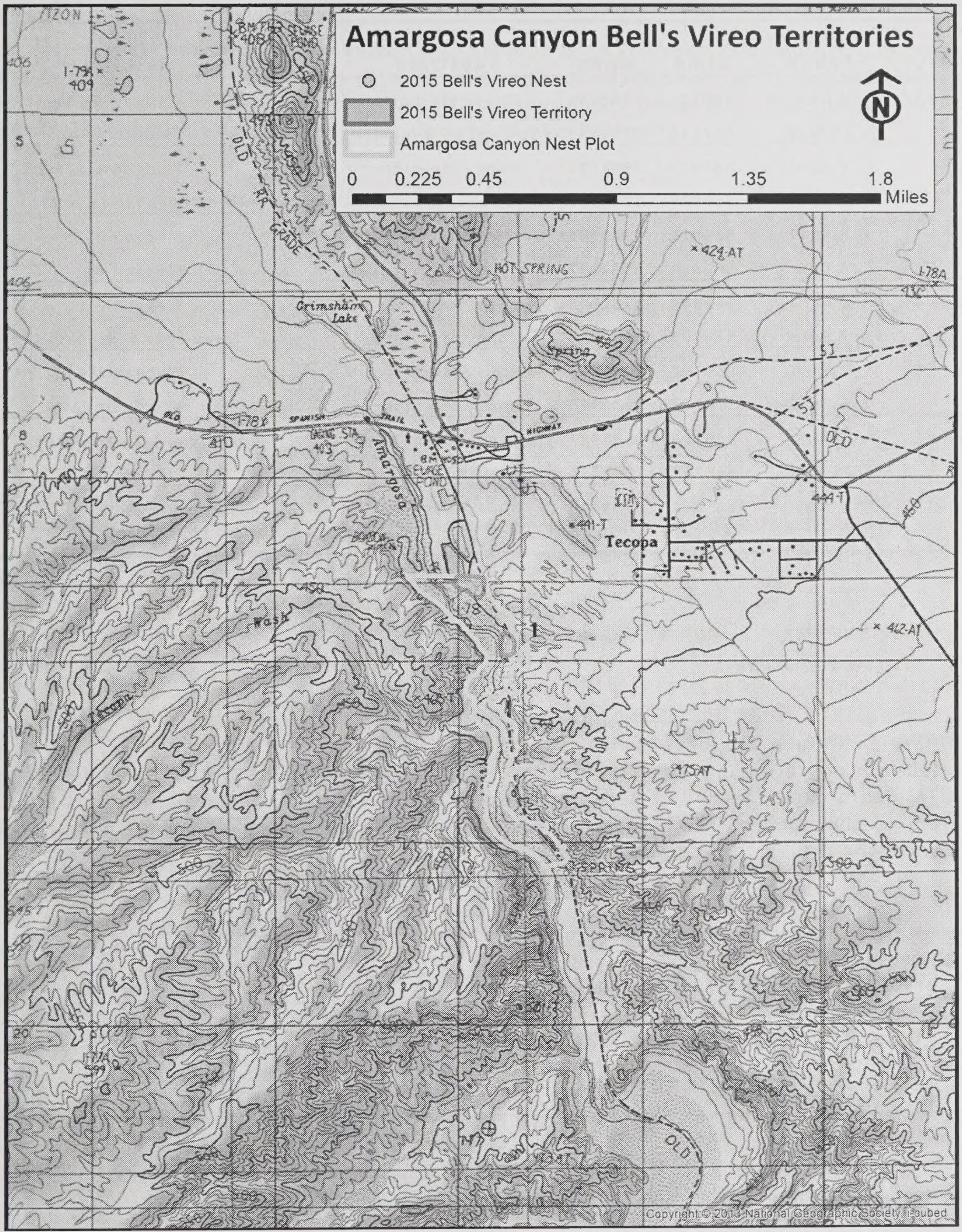
Amargosa Canyon Bell's Vireo Territories
○ 2015 Bell's Vireo Nest
▨ 2015 Bell's Vireo Territory
☐ Amargosa Canyon Nest Plot
0
0.225
0.45
0.9
1.35
1.8
Miles
N
HOT SPRING
Grimshaw Lake
Amargosa
Tecopa
Wash
SPRING
OLD
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Figure 3b. Bell's Vireo territory locations, Amargosa Canyon North plot (2015).

Table 1. Bell's Vireo nest locations and outcomes, 2015. Coordinates in NAD83 Zone 11.

Territory	Date Found	utme	utmn	Substrate	Result
Shoshone 1	4 April	566174	3981586	Honey Mesquite	Fledged 4
	29 May	566111	3981531	Screwbean Mesquite	Fledged 4
Shoshone 2	4 April	565972	3981685	Honey Mesquite	Fledged 4
	29 May	566025	3981658	Screwbean Mesquite	Three eggs fail to hatch
Shoshone 3	7 April	566013	3982305	Screwbean Mesquite	Fledged 2
	6 June	566010	3982332	Quailbush	Fledged 4
Shoshone 4	8 April	566343	3981245	Baccharis sp.	Fledged 2
	9 June	566405	3981186	Honey Mesquite	Three eggs depredated
Shoshone 5	9 April	566197	3981339	Honey Mesquite	Fledged 2
	6 June	566217	3981365	Honey Mesquite	Four eggs depredated
Shoshone 6	10 April	566310	3981387	Honey Mesquite	Four young depredated
	28 May	566252	3981334	Screwbean Mesquite	Fledged 3
Shoshone 7	1 May	565562	3981992	Honey Mesquite	Fledged 2
(off plot)	30 June	565493	3981984	Honey Mesquite	Three eggs fail to hatch

2.2 Willow Flycatchers

We again failed to locate paired Willow Flycatchers on the Amargosa River, though we detected four migrating individuals while spot-mapping on nest plots. Table 2 lists detections and UTM coordinates, as well as behavior. Several follow-up visits to these locations did not yield paired flycatchers. We have not found paired Willow Flycatchers on any of our three plots since the project's inception in 2005.

Table 2. All Willow Flycatcher detections on the Amargosa River, Inyo County, CA in 2015.

Date	Scheduled Survey?	Plot	Number	utme	utmn	Comment
5/15/2015	No	AMNO	1	565929	3966588	Whits all morning, 25-30 Fitzbews
5/16/2015	No	SHOS	1	566375	3981249	30-40 whits, 3 Fitzbews
5/18/2015	No	AMNO	1	569939	3966663	40-50 whits, 4 Fitzbews
5/26/2015	No	AMNO	1	569970	3966584	40-50 whits, 10 Fitzbews

2.3 Nesting Species

Of 64 active nests monitored with known outcomes in 2015 (all species combined), 44 fledged young, a 69% proportional success rate. Annual success rates have varied between 63% and 90% since 2011 (Table 3). Thirty-three of 50 open-cup nests fledged in 2015 (66%), and 32 of 47 potential cowbird host species nests fledged (68%) (Table 4).

Table 3. Number of successful nests, total nests, and proportional success (all species combined) at the Amargosa River, CA.

Year	Successful Nests	Total Nests	Proportion Successful
2011	61	68	90%
2012	34	54	63%
2013	54	76	71%
2014	70	83	84%
2015	44	64	69%

Cowbird parasitism rates of potential host species' nests was roughly 40% prior to the initiation of cowbird trapping in 2007. As we have eliminated cowbirds from the system through trapping, host productivity (measured by fledglings produced per brood attempt) has approximately doubled (Figure 4).

Of the 20 total nests that failed in 2015, 7 (35%) failed due to unhatched/abandoned eggs. This desertion rate mirrors desertion rates in recent years, all recorded during a prolonged, severe drought. 2011 was the last breeding season on the Amargosa River under drought-free conditions U.S. Drought Monitor archives, http://droughtmonitor.unl.edu/Home.aspx), and we coincidentally recorded our highest proportional success and productivity per brood attempt in 2011 (Figure 4).

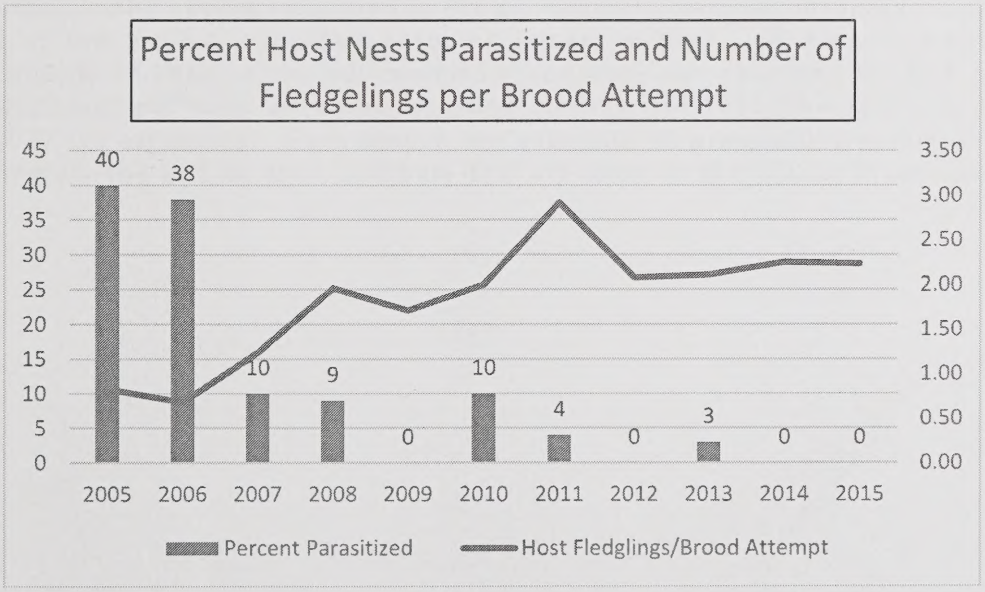

Figure 4. Percent of potential Brown-headed Cowbird (*Molothrus ater*) nests parasitized by cowbirds (blue bars with percentages labeled) and host productivity (fledglings/ brood attempt, red line), Amargosa River, CA.

Table 4. All active nests located and monitored in 2015 at the Amargosa River, Inyo County, CA. "Active nest" refers to a nest that was observed with eggs or young at some point, and thus nests that were abandoned during building or nests with unknown outcome are excluded. (*) = Potential Brown-headed Cowbird host. In total, 44 out of 64 nests fledged young, 69% proportional success. Eleven of 14 (79%) cavity or dome nests fledged young, and 33 out of 50 cup nests fledged young, 66% proportional success.

Species	Nest Type	Management Status	Successful Nests/Total Nests
Bell's Vireo*	cup	State and Federally Endangered	9/14
Bewick's Wren	cavity		2/2
Black-tailed Gnatcatcher*	cup		7/13
Blue-gray Gnatcatcher*	cup		0/1
Common Raven	cup		2/2
Crissal Thrasher	cup	California Species of Special Concern	0/1
Lucy's Warbler*	cavity	California Species of Special Concern	1/1
Red-tailed Hawk	cup		0/1
Say's Phoebe	cavity		1/1
Song Sparrow*	cup		1/1
Verdin	dome		7/10
Yellow Warbler*	cup	California Species of Special Concern	7/9
Yellow-breasted Chat*	cup	California Species of Special Concern	7/8

2.4 Brown-headed Cowbird Trapping

We have captured and euthanized 400 female cowbirds in eight years of trapping (Table 5). Cowbird parasitism was once a common event on the study plots. After trapping began in 2007, we reduced cowbird parasitism to zero in 2009. A handful of nests were lost to cowbird activity in 2010, a year without trapping. Only one nest (for all species combined) appears have been lost to cowbird activity in 2011, 2012, and 2013 each, and zero nests were lost to cowbird activity in neither 2014 nor 2015. In 2014 we caught our first juvenile cowbird in seven years. It was captured on June 27, one of the last days of trapping. It was never observed during our nest monitoring activities on plots, and it may have been dispersing from an off-site.

Table 5. Total Brown-headed Cowbird captures at Amargosa River, Inyo County CA. All females were euthanized. Male and juvenile captures may represent duplicates as excess male and juvenile captures were periodically released and recaptured.

	Begin Date	Females	Males	Juveniles
2007	2 June	26	111	20
2008	8 May	84	164	0
2009	23 April	93	82	0
2011	9 May	68	104	0
2012	9 May	49	93	0
2013	6 May	19	30	0
2014	3 May	49	40	1
2015	4 May	12	22	0

Table 6 illustrates the severe reduction in Brown-headed Cowbirds observed on plots during the course of the Project. Cowbird trapping began in 2007. Of note, cowbird numbers increased slightly in 2010, when our cowbird traps were not operated for lack of funding. Cowbird detections per hour were not recorded in 2011 and 2012 (the values in Table 5 for 2011 and 2012 are estimates). Each season, we extirpate all prospecting immigrant cowbirds by approximately the end of May, and very few are seen as the season moves deeper in to June.

Table 6. Brown-headed Cowbirds observed per hour and per day on the SHOS, AMNO, and AMSO plots (2006-2015). *2011 and 2012 values are estimates.

Year	Cowbirds detected/hour	Cowbirds detected/day
2006	2.22	13.2
2007	2.54	10.8
2007	0.51	2.9
2009	0.11	0.6
2010	0.47	2.37
2011*	0.10	0.50
2012*	0.1	0.5
2013	0.13	0.67
2014	0.07	0.42
2015	0.01	0.03

Incidental captures of non-target species in cowbird traps has occurred rarely over the course of the project, and four non-target individuals were lost to mortality in 2014 and 2015 combined (Table 7).

Table 7. Incidental captures of non-target species at Brown-headed Cowbird traps, Amargosa River, CA. (*) denotes that incidental captures of House Sparrows and House Finches were not individually logged at the Crowbar restaurant in Shoshone. It is estimated that 15 resident House Sparrows and 10 House Finches were captured repeatedly over the course of the season in both 2014 and 2015.

Year	Species	#	Age	Location	Outcome
2014					
23-May	House Finch	1	adult female	China Ranch bakery	released
23-May	Bewick's Wren	1	unknown age	China Ranch bakery	died unknown cause
5-Jun	House Finch	1	adult female	China Ranch bakery	released
6-Jun	Gambel's Quail	1	juvenile	Crowbar restaurant	released
21-Jun	Loggerhead Shrike	2	juveniles	Tecopa shed	one killed by other shrike, 2nd released
25-Jun	Loggerhead Shrike	2	juveniles	Tecopa shed	one killed by other shrike, 2nd released
27-Jun	House Sparrow	3	juveniles	Crowbar restaurant	released
30-Jun	Loggerhead Shrike	1	adult	Tecopa shed	released
*	House Sparrow	15	mixed	Crowbar restaurant	
*	House Finch	10	mixed	Crowbar restaurant	
2015					
20-Jun	Loggerhead Shrike	1	juvenile	China Ranch bakery	died unknown cause
*	House Sparrow	15	mixed	Crowbar restaurant	
*	House Finch	10	mixed	Crowbar restaurant	

2.5 Territory Density

Tables 8a and 8b list territory numbers by species and total at the AMNO and SHOS plots respectively. Territory numbers have risen dramatically during the study for many species, particularly amongst potential cowbird host species. Accumulated effects of long-term drought and *Tamarix* removal on the AMNO plot prior to the 2015 breeding.

Table 8a. Territory numbers on the Amargosa Canyon North plot (AMNO) by year. Pre-Trap Average is the average taken from 2005, 2006, and 2007. The AMNO plot is approximately 33 ha.

Species	Pre-Trap Average	2010	2011	2012	2013	2014	2015
American Kestrel	1.00	1	1	0	0	0	0
Ash-throated Flycatcher	2.67	2.5	2	2	2	2	3
Brown-crested Flycatcher	1.83	2	2	0.5	1	1	1
Bell's Vireo	0.33	2	1	1	2	0	2
Bewick's Wren	4.33	7	7	6	1.5	2	4
Black-tailed Gnatcatcher	1.00	3	4.5	5	3	5	5
Blue-gray Gnatcatcher	0.33	0.5	2.5	0	0	0	0
Blue Grosbeak	6.83	5	5.5	8	4	4	2
Costa's Hummingbird	0.33	0	0	0	0	0	0
Common Raven	1.00	1	1	1	1	1	1
Common Yellowthroat	12.83	22	21	23	26	30	25
Crissal Thrasher	5.00	7	5.5	6	5	4	4
Green Heron	1.00	0	1	1	1	1	1
Greater Roadrunner	1.00	1	1	1	1	1	1
Hooded Oriole	0.00	0	0	0	0	0	0
House Finch	0.33	1	2	1	1	0	0
Indigo Bunting	0.00	2	1.5	2	0	0	0
Ladder-backed Woodpecker	1.50	1	2	2	1	0.5	0.5
Loggerhead Shrike	0.33	0	0	0	0	0	0
Long-eared Owl	0.00	0	0	0	0	0	0
Lucy's Warbler	2.67	6	1	1	0	0	0
Mourning Dove	1.67	1	2	1	1	0	0
Phainopepla	0.00	2	1	0	0	0	0
Red-tailed Hawk	1.00	2	2	2	1	1	1
Rock Wren	0.50	0	1	1	1	1	1
Say's Phoebe	2.00	0	2	2	1	1	2
Song Sparrow	7.00	11	11	13	20	22	13
Verdin	4.50	3	4.5	5	4.5	6	5
Virginia Rail	0.33	1	2	2	1	1	1
Western Kingbird	0.67	0	0	0	0	0	0
Willow Flycatcher	0.33	0	1	0	0	0	0
Yellow-breasted Chat	10.17	11.5	12.5	19	12.5	17	14
Yellow Warbler	7.67	11	8	12	9	15	11
TOTAL	**80.17**	**107**	**109**	**117.5**	**100.5**	**115.5**	**97.5**

Table 8b. Territory numbers on the Shoshone (SHOS) plot by year. Pre-Trap Average is the average taken from 2006 and 2007. The SHOS plot is approximately 32 ha

Species	Pre-Trap Average	2010	2011	2012	2013	2014	2015
American Kestrel	0.50	0	0	0	0	0	0
Ash-throated Flycatcher	2.00	2	2	2	2	2	1
Brown-crested Flycatcher	0.00	0	0	0	0	0	0
Bell's Vireo	0.00	4.5	2.5	6	5	5	6
Bewick's Wren	7.25	6	8	11	11	17	10
Black-tailed Gnatcatcher	2.00	2	4.5	4	7	14	14
Blue-gray Gnatcatcher	3.50	7	7	9	7	8	8
Blue Grosbeak	4.25	4.5	4.5	4	3.5	3	2
Costa's Hummingbird	0.00	0	0	0	0	0	0
Common Raven	2.00	2	2	2	2	2	2
Common Yellowthroat	3.25	4	3	3	0	0	0
Crissal Thrasher	5.00	8	10	10	11	16	14
Green Heron	0.00	0	0	0	0	0	0
Greater Roadrunner	1.00	1	2	1	1	1	1
Hooded Oriole	0.00	1	1	1	1	1	1
House Finch	2.25	4	5	5	5	5	5
Indigo Bunting	0.00	2	2.5	1	0	0	0
Ladder-backed Woodpecker	0.25	0	0	0	0	0	0
Loggerhead Shrike	0.00	0	0	0	0	0	0
Long-eared Owl	0.00	0	0	0	0	0	0
Lucy's Warbler	0.50	8	11	7	9	13	12
Mourning Dove	0.50	1	1	1	1	1	1
Phainopepla	8.25	12	18	16	19	16	18
Red-tailed Hawk	0.00	0	0	0	0	0	0
Rock Wren	0.00	0	0	0	0	0	0
Say's Phoebe	1.00	1	1	1	1	1	1
Song Sparrow	2.00	0	3	3	2.5	4	3
Verdin	25.50	18	18	24	20.5	21	21
Virginia Rail	0.00	0	0	0	0	0	0
Western Kingbird	0.00	0	0	0	0	0	0
Willow Flycatcher	0.00	0	0	0	0	0	0
Yellow-breasted Chat	8.25	9	3	4	4	3	3
Yellow Warbler	0.50	0	0	0	0	0	0
TOTAL	**79.75**	**97**	**109**	**115**	**112.5**	**133**	**123**

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